AGRICULTURAL
Research
U.S. DEPARTMENT OF AGRICULTURE

MAY 1969

TEAM ALFALFA
Page 8

AGRICULTURAL
Research

May 1969/Vol. 17, No. 11

Aiding Human Health

The word *health* in an agricultural sense usually conjures up pictures of robust crops and livestock and an abundance of nutritious food. Yet agricultural scientists are also making an impact on the health of our people. For man, land, plants, and animals are interwoven in the web of life. In combating the pathogens and hazards that beset them all, ARS scientists over the years have devised means to prevent, diagnose, and treat many human ills.

Early in the 1890's, for example, Theobald Smith and F. L. Kilborne solved the mystery of Texas cattle fever with a momentous discovery: A tick could transmit disease. Certain insects and mites were also labeled carriers of disease by scientists of other lands. When the mosquito was linked with yellow fever, Smith's colleague, L. O. Howard, provided the basic information for eradicating the pest and controlling the disease. This cleared the way for completion of the Panama Canal. Later, during World War II, scientists forged efficient weapons against other pestborne diseases such as malaria, encephalitis, and bubonic plague—an effort that saved millions of lives.

More recently, the discovery that one form of poultry cancer can be transmitted by direct contact between birds gives added support to scientists who believe that viruses may cause some kinds of cancer. In another project, scientists found a new source of an enzyme that inhibits leukemia. Botanists, meanwhile have been combing the world for plants containing substances with a potential for treating cancer.

A few of the other contributions of agricultural scientists to human medicine include a method for producing dextran, a vital blood extender for victims of shock; a risk-free and highly specific test for allergy with implications for future medical practice and research; a sweet clover extract which helps prevent blood clots; a simple and sensitive test for diagnosing galactosemia, a rare but severe metabolic disease of infants; and, still under development, a high-calorie cottonseed oil emulsion for patients who require extended intravenous feeding.

These ARS contributions will be augmented as scientists continue to close gaps in knowledge and raise the level of our well-being.

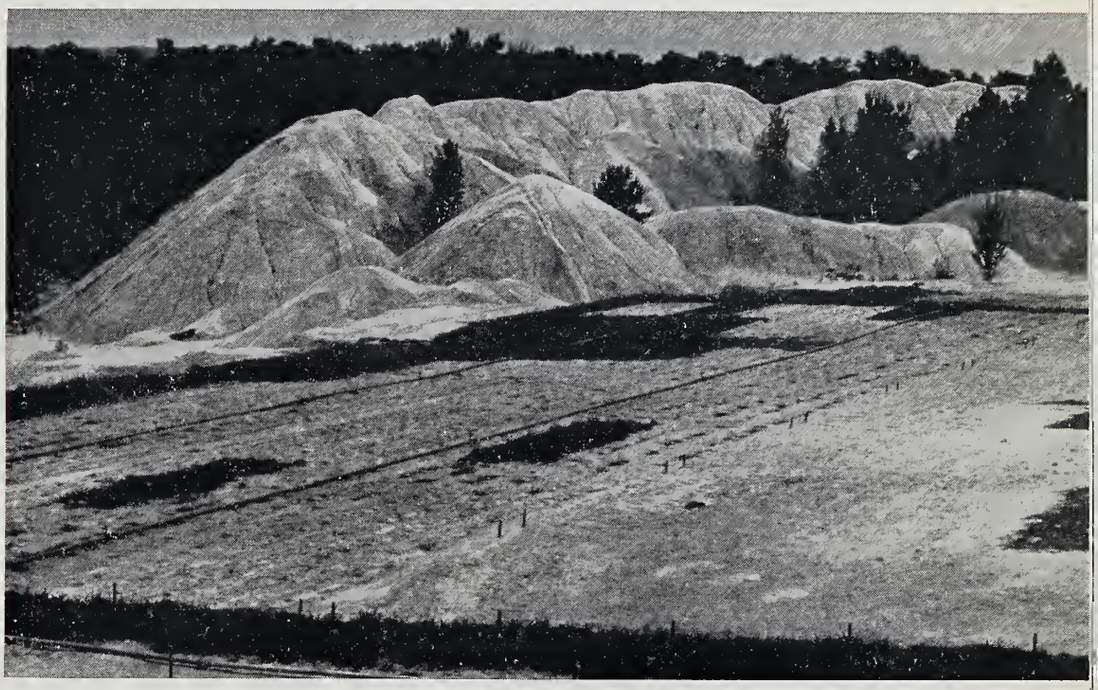
Editor: R. P. Kaniuka
Managing Editor: E. H. Davis
Contributors to this issue:
R. C. Bjork, J. P. Dean,
M. C. Guilford, M. B. Heppner,
W. W. Martin, D. H. Mayberry,
D. P. Movitz, S. A. Oring,
M. F. Tennant, D. M. Webb

AGRICULTURAL RESEARCH is published monthly by the Agricultural Research Service (ARS), United States Department of Agriculture, Washington, D.C. 20250. Printing has been approved by the Bureau of the Budget, June 1967. Yearly subscription rate is $1.50 in the United States and countries of the Postal Union, $2.00 in other countries. Single copies are 15 cents each. Subscription orders should be sent to Superintendent of Documents, Government Printing Office, Washington, D.C. 20402.

Clifford M. Hardin, Secretary
U.S. Department of Agriculture

G. W. Irving, Jr., Administrator
Agricultural Research Service

Revitalizing the land takes two steps. First, the spoil has to be leveled so seed and fertilizer won't wash away. Then, deficiencies in plant nutrients must be corrected. Here, experimental grass plots lie on the leveled spoil (PN–1775)



Bringing Back Life

ONCE THIS LAND was rich in kaolin. Now it lies gutted, stripped of its treasure, bulldozed into wasteland. Some 10,000 acres of Georgia land with no grass, no trees, no wildlife.

Its wealth, kaolinite clay, is sought for the production of paper, rubber, paint, plastics, and other industrial products. The market for the clay is expanding, spurring the strip mining and spreading the devastation.

Reclamation of kaolin-mined lands is now required by Georgia law, and some 900 to 1,000 acres have been reclaimed following research by scientists of ARS and the Georgia Agricultural Experiment Stations. Vegetative cover was restored to prevent further depletion of the land by erosion, and the area was made habitable for small game animals.

The scientists are cooperating with the Kaolin Strip Mining Reclamation Research Advisory Committee, organized by mining companies to advance reclamation. When the researchers have found the key to reclaiming the spoil, the Georgia law will require mining companies to replant as their machines move across the land. Other areas devastated by strip mining may also benefit from this research.

Working on the study are ARS soil scientist C. L. Parks stationed at Watkinsville, Ga., along with agronomist H. F. Perkins and forester J. T. May of the University of Georgia at Athens.

Parks found that when enough nitrogen, phosphorous, potassium and lime are applied to the kaolin mine spoil, it's possible to establish Ladino clover and grasses. May is having moderate success in getting loblolly pine seedlings to survive.

After greenhouse studies involving Ladino clover, Parks conducted field trials with plantings of rye, ryegrass, fescue, and three lespedezas—kobe, sericea, and virgata. Rye and ryegrass came up well but lasted only one year. Fescue and the lespedezas also germinated well and stabilized the spoil. Now the plots provide rabbits, quail, and other wildlife with feed and cover.

May is researching tree plantings and hydroseeding with grasses and grains on steep, deep-gullied slopes. Success has been varied, but his study indicates that hydroseeding, by air or ground machine, may be an effective way to get quick grass cover on rugged terrain.■

a tie that binds . . .

WHY DOES HEATING lower the nutritive value of protein in some vegetables?

The answer is important to a protein-hungry world where millions must depend on vegetable proteins for body growth and maintenance.

Nutritionists have known for years that some amino acids in vegetable proteins cannot be used by the body after the vegetables have been heated—the higher the temperature and the longer the cooking time, the greater the loss of nutritive value. They are convinced that this is not due to any decrease or change in the amino acid content of the protein, but rather that heating makes the acids unavailable to the body.

Since the acids are inactivated in foods such as beans, corn, and potatoes that are rich sources of carbohydrate as well as protein, nutritionists suspected that they are somehow tied up by carbohydrates during the heating process. But there were no experimental techniques for getting these two nutrients to react to reveal meaningful information.

Now, a team of Beltsville biochemists led by M. J. Horn has synthesized an amino acid-carbohydrate compound that could be the key to the mechanism by which the amino acid methionine—and perhaps others—is rendered unavailable to the animal body. Studying such a compound should simplify the research and eliminate the use of whole foods, a time-consuming and expensive necessity in previous research.

In deciding to work on model compounds, the ARS investigators planned to set up the model system, isolate the compound formed, and then study its availability to microorganisms and laboratory rats. Methionine was chosen for the first model compound because it is limited in most vegetable proteins.

The work of "building" the new compound began with free methionine and a simple carbohydrate, glucose, heated together under controlled conditions. The action of the glucose on the methionine resulted in a compound (1-deoxy-1-methionino-D-fructose) described as a light tan, amorphous powder that readily absorbed moisture and contained only a small amount of free methionine.

When the compound was fed to lactic acid bacteria, selected because they require free methionine for growth, only 80 percent was usable compared to 100 percent for free methionine. When fed to rats, none of the methionine in the compound was usable.

The results bear out previous evidence that this particular protein component reacts with carbohydrates when heated to form obscure complexes that are inferior to the methionine itself. The model compound may make it possible to explain the nature of the complexes formed in protein.

Further research involving two or three other amino acids joined with methionine will reveal the combinations formed from these compounds and glucose.

Threonine, another amino acid often in short supply in foods, is also being tested for its combinations with glucose. The properties of the resulting compounds are being studied.■

Top: *Horn checks progress of synthesis of model compound (ST–4584–18).* **Middle:** *He prepares to remove the solvent from sugar-amino acid solution (ST–4584–12).* **Bottom:** *Test rat samples model compound (ST–4583–3).*

survey uncovers promising

ANTIBIOTIC

AN ANTIBIOTIC that acts against yeast has been found by ARS scientists.

Yeasts infect humans and animals weakened by other diseases and some yeasts cause secondary infections in cancer patients. Few available antibiotics act against them.

The new antibiotic, called brassicicolin A, was isolated from crude compounds produced by one strain of the mold *Alternaria brassicicola*. The strain is one of 127 in the *Alternaria* genus surveyed for antibiotics production at the ARS Northern utilization research laboratory, Peoria, Ill. The survey uncovered 86 producers of antimicrobial compounds, including 26 yeast inhibitors.

Crude compounds from *A. brassicicola* were selected from the most promising yeast inhibitors for study as antibiotics. ARS microbiologist Alex Ciegler isolated brassicicolin A and described it. In assays L. A. Lindenfelser, also a microbiologist, found that three yeasts, five molds, and two bacteria stopped growing when exposed to the antibiotic.

One of the yeasts infects the urinary tract—the assay yeast was isolated from a kidney infection in a cancer patient. Another causes a rare but serious infection of the nervous system, including the spinal cord and brain. The third yeast sometimes causes boils in humans and mastitis in cattle.

Two of the molds cause skin infections like ringworm. One bacteria has been associated with respiratory ailments. The other bacterium and three molds cause plant diseases.

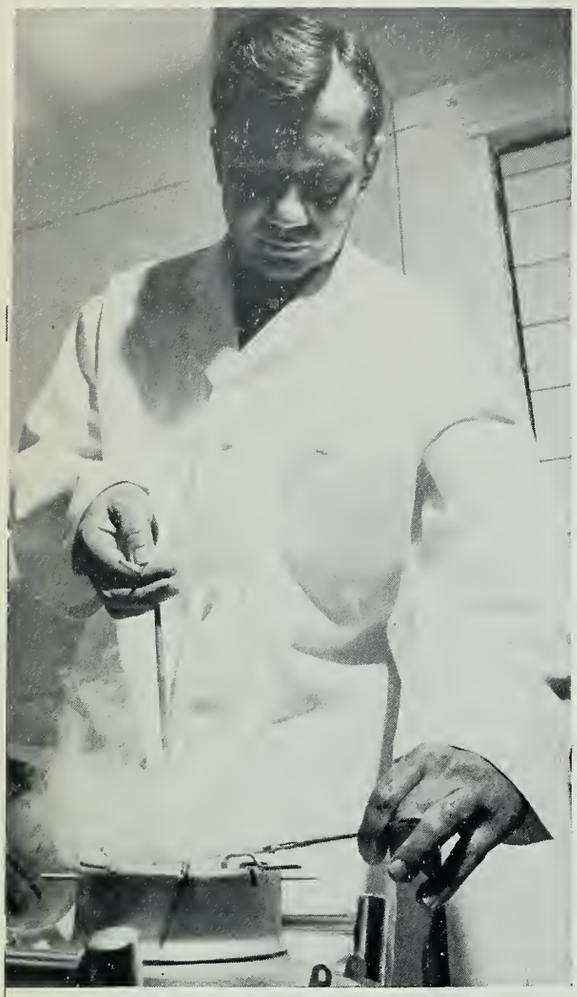
Only three antibiotics from *Alternaria* molds had been described before Ciegler and Lindenfelser surveyed the genus for antibiotic production. And only two genera of molds, *Aspergillus* and *Penicillium*, had been surveyed intensively. A genus of bacteria called *Streptomyces*, however, is the richest known source of commercial antibiotics.

Next step for brassicicolin A is to identify it by chemical family, which will enable scientists to predict the probability of toxicity to animals.

The research is part of a program to screen organisms in the ARS Culture Collection at the Northern laboratory for antibiotic properties. First major development in the program was an industrial process for producing penicillin.

Most recent development before brassicicolin A was the discovery of new microbial sources of the enzyme, L-asparaginase, which inhibits leukemia. Closely related is a finding that tempeh, a fermented soybean food, contains compounds that inhibit growth of bacteria and may stimulate growth and increase disease resistance in animals and man (AGR. RES. April 1969, p. 5).■

Below: *Ciegler indicates dark zones where yeast doesn't grow because of brassicicolin A seeping from paper disks at zone centers (PN–1777).* **Right:** *Lindenfelser inoculates nutrients with microorganisms in assay of different concentrations of brassiciolin A (PN–1776).*



frozen BOAR SEMEN ...can it remain viable?

RESEARCHERS are analyzing the fat composition of boar semen for hints on why the semen will not withstand freezing.

Frozen bull semen shipped from collection centers to cattle breeders in all parts of the world has, for many years, done much to improve dairy cattle. The swine industry has hope for a similar benefit from frozen semen, especially with recent success in obtaining synchronized estrus in sows (AGR. RES., Sept. 1965, p. 3).

Although unfrozen boar semen has been used successfully, it deteriorates rapidly, so only about one-tenth of one percent of the 15 million swine matings done yearly in the U.S. are made by artificial insemination. Attempts to handle boar semen like bull semen—by freezing, thawing, and then inseminating it—have not yet succeeded because after freezing, boar semen does not fertilize the egg.

ARS biochemist L. A. Johnson has been pursuing a chemical study of boar semen at Beltsville, Md., for the past 2½ years with cooperation from physiologists R. J. Gerrits of ARS and E. P. Young of the University of Maryland, College Park. Attention centers on fats, or lipids, which are interlaced with protein to make up a large proportion of the outer membrane of the sperm cell.

By their location, lipids influence the permeability of the membrane to chemicals, such as those used to preserve semen, and they may help protect the sperm cell against adverse conditions, such as freezing.

Johnson has pretty well finished typing the lipids. As in most species, about 70 percent of the fats are phospholipids—a group of about eight so named because they contain an atom of phosphorous.

Boar sperm cell phospholipids proved unusual, however, because they contain a high proportion of unsaturated, long-chain fatty acids, the building blocks of lipids. In most animal tissue, the average level of unsaturated fatty acids with as many as 22 carbons in a chain is 5 to 30 percent. But in the boar sperm cell, the proportion of unsaturated fatty acids containing 22 carbons is nearly 60 percent. Whether this unusual makeup is related to the sperm cell's freezability remains to be seen.

Knowing these intricate details about lipid composition, Johnson is now going on to freeze boar semen and to determine changes in the proportion and amount of its phospholipid and fatty acid composition. Some of the components may be chemically altered, but more likely, Johnson says, the freezing process sloughs off some of them. When Johnson determines which critical lipids are lost, research can be designed to find ways to avoid this loss.■

Above: *Technician G. H. Thomas takes samples out of liquid nitrogen storage (ST–4316–16).* **Right:** *Johnson operates thin-layer sample streaker to apply crude phospholipid extracts for separation into component phospholipids (ST–4316–7).* **Far right:** *Assistant J. L. Schroeder injects samples into chromatograph to separate phospholipid fatty acids. Recorder registers results (ST–4316–3).*

Laboratory technicians at Plum Island handle infectious virus materials in safety hoods equipped with attached rubber gloves. This device confines any virus material and helps prevent contamination of the laboratory (N–19031).

Vaccinated Cattle . . .

can harbor FOOT and MOUTH Disease

DESPITE VACCINATION, cattle can still develop an active infection in their throats when exposed to an outbreak of foot-and-mouth disease.

The throat infection is apparently possible because not enough blood antibodies reach there to prevent virus colonization and multiplication. Until recently, the throat infection was difficult to detect and generally went unnoticed.

But scientists at the ARS Plum Island Animal Disease Laboratory, Greenport, N.Y., found they could detect virus in throat scrapings more easily if they emulsified the samples with trichlorotrifluoroethane. The treatment apparently frees some virus from antibodies or other substances. The new throat test is now in use to tighten health examinations of cattle being imported into the United States. Along with quarantine, diagnostic tests done on imports have helped keep the country free of foot-and-mouth disease for more than 30 years.

Studies of virus growth in the throat were conducted by ARS veterinarians Paul Sutmoller, J. W. McVicar, and G. E. Cottral. They used three groups of steers: One group was unprotected against foot-and-mouth disease; the second was immunized with antibodies contained in blood serum; the third was vaccinated with inactivated virus. All groups were later exposed to virus placed in the nose or throat.

As expected, many of the unprotected steers came down with foot-and-mouth disease, but most serum-immunized or vaccinated cattle remained healthy. Scientists found, however, that about 70 percent of the steers in all three groups carried virus in the throat for a long time.

Some of the cattle with throat infections had a full-blown case of the disease; some had only a slight fever; and others—including some unprotected steers—had no clinical signs of disease whatever.

Throat infection seemed to occur independently of the seriousness of disease symptoms. But even apparently healthy vaccinated carrier steers coughed out droplets containing fully virulent virus for as long as 1 month after being infected.

The researchers were surprised that steers with throat infections do not transmit foot-and-mouth disease readily. There is no record of cattle carrying virus infecting other cattle under experimental conditions, although evidence from farm cases overseas has pointed to carriers as a cause of new outbreaks in cattle.

Specific transmission experiments were done at Plum Island with 12 carrier cattle and 28 normal pigs in mixed groups. No pigs developed obvious disease symptoms although two of them developed antibodies against foot-and-mouth disease. However, when scientists later inoculated throat samples from the carrier cattle directly into the pigs, all but one of the pigs readily became sick. The exception was one of the two that had picked up foot-and-mouth disease antibodies earlier in the trial.■

Cover: *Hanson hand-pollinates alfalfa blossom (ST–4674–27).* **Left:** S. D. *Brown removes weevil eggs from artificially infested plants. Stems may contain from 100 to 200 eggs (ST–4675–6).* **Below:** *Eggs are carefully brushed from stems for incubation and rearing (ST–4677–1).* **Right:** *Entomologist R. F. W. Schroder places eggs in cup of experimental artificial diet (ST–4678–3).*

TEAM Alfalfa Scores High

TEAM, a new high-yielding alfalfa variety, can give farmers a moneysaving lift in their fight against alfalfa weevils, several plant diseases, and pea aphids.

Although not a panacea, Team is an important step toward USDA's goal of incorporating resistance to a broad range of diseases and insects in commercial varieties. Resistance assures better yields and quality, longer-lived stands, and lower insect and disease control costs. Resistance is not affected by weather conditions as are conventional pesticides, nor does it leave residues or pose a threat to bees and other beneficial insects.

Team is a product of more than 10 years of intensive research led by ARS plant breeder C. H. Hanson. Its name honors the cooperative efforts of ARS and the agricultural experiment stations of Maryland, North Carolina, and other States. Team was developed for the Maryland-Virginia-North Carolina area, but tests are now underway on its suitability for other areas.

No other tested variety in certified seed production has as much resistance to alfalfa weevils as Team, according to studies by ARS entomologist R. H. Ratcliffe. Although this resistance is a major asset, scientists regard it as moderate and expect to increase it with further research.

Tests by ARS geneticist, D. K. Barnes showed that Team is fairly resistant to anthracnose, a disease that can destroy an entire stand in one year. This resistance is one of the new variety's most important traits. It also has greater resistance to common leafspot, *Stemphylium* leafspot, and pea aphids than other popular varieties.

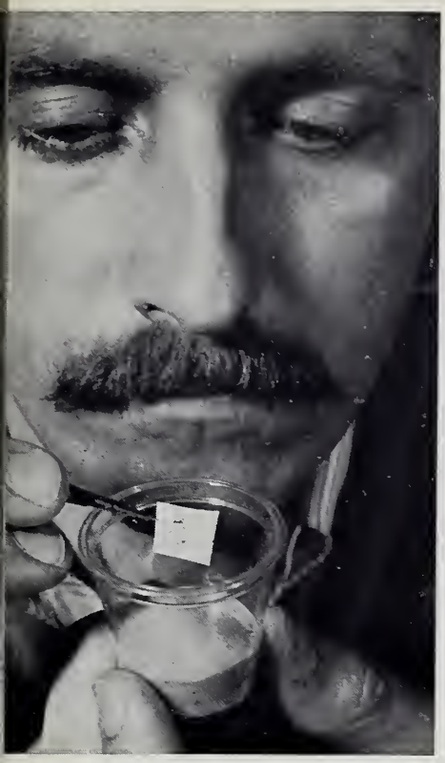
Team is moderately susceptible to one potential problem—bacterial wilt, but this disease is of more concern in areas north of Maryland.

In other regards, Team holds its own. At Prosser, Wash., ARS agronomist C. M. Rinker found that Team's seed production is comparable to that of other alfalfa varieties. And at the University of Maryland, cattle ate Team as readily as other varieties. Team was also found equal in digestibility.

Certified seed will be available from commercial seedsmen for spring planting in 1970. USDA has no seed available for distribution to individual growers.

WORK ON TEAM began in 1957 when Hanson, then stationed at Raleigh, N.C., started screening alfalfa varieties for plants that showed more than average resistance to alfalfa weevils.

In 1958, Hanson transferred to Beltsville, Md., and became coordinator of expanded research on alfalfa by ARS scientists and cooperating State



Flats of alfalfa inoculated with disease organisms are examined by Hanson who uproots plants showing susceptibility to disease (ST–4674–15).

agricultural experiment stations. More than a million plants have been evaluated in field and laboratory studies. Team's forebears were screened for their performance under various conditions of stress from disease and insect pests. Yield and other desirable agronomic traits were tested in related studies.

In selection for one trait alone—weevil resistance—Team went through six generations of testing. Hanson and his associates selected the best plants for succeeding generations on the evidence of different kinds of weevil resistance (AGR. RES., April 1967, pp. 3–5).

Ratcliffe and other ARS entomologists on the research team at Beltsville studied adult weevils' preference or nonpreferences of plants for both food and egg-laying sites. Larval feeding studies rounded out the selection process for each generation.

Close coordination between seed production phases and field tests expedited development of Team. Every spring, plants from Beltsville were air-expressed to ARS agronomist O. J. Hunt at Reno, Nev. There, caged field plots equipped with honey bees assured adequate pollination under better environmental conditions for seed production than available in the Mid-Atlantic States.

By late August, ample seed was available for field tests of weevil infestations in North Carolina by ARS geneticist T. H. Busbice. At the same time, tests with the next generation were initiated in the Beltsville laboratories by Barnes and Ratcliffe.

In the sixth generation, numbering about 46,000 plants, the scientists selected 145 as the parent stock of Team. On the basis of the improved alfalfa stands that can be expected, seed production by Team's parent stock should pay off in a high return per dollar invested in the research.■

Ratclffe checks weevils feeding on caged plants (ST–4689–15). Below, weevil larvae are placed on pegs in feeding tests (ST–4689–4).

Cavities were mined at the bottom of recharge shafts 100 feet below ground surface to increase recharge rate (PN–1778).

RECHARGE SHAFTS

can save water in Texas High Plains

SHAFTS THAT RETURN surface runoff to natural underground formations may be more satisfactory than wells to recharge ground-water supplies.

The need for artificial recharge, long recognized as a good method of conserving surface water, is especially urgent in the Texas High Plains. There, the demand for irrigation water is causing a serious decline in ground-water levels. Natural recharge is almost nil, and the only recurring source is rainfall. About 10 percent of the surface runoff water enters a stream system. The rest runs into natural depressions called playas where most of the water evaporates. If that water—about 2.5 to 3.0 million acre-feet annually—could be conserved, it would prolong the area's large-scale irrigated agriculture or support a smaller irrigated area indefinitely.

Research and practice on artificial recharge has been mainly directed to recharging through wells because slowly permeable layers of soil and underlying strata can easily be bypassed to get to the aquifer (water-bearing layer) quickly.

Lately, however, ARS researchers are studying shafts as a better method. They say the shafts, well-like openings that terminate above the water table, result in less biological pollution to the aquifer and less chance of damage to the aquifer by sediment. Shafts also cost less than wells.

The shafts may be lined with casing or filled with gravel to stabilize the sides while allowing water to seep down. Effectiveness depends on ability to accept recharge water, which depends upon the material in which the shafts terminate. A disadvantage of shaft recharge, however, is that sediment plugging the shaft cannot be removed by reversing the water flow as in a pumped well. A jetting or washing operation might overcome surface sealing, say the scientists, but it would be better to recharge only with clear water.

To minimize water losses, recharge rates will have to exceed 500 gallons per minute (gpm), the evaporation rate on a 100-acre playa during May and June, the months of heaviest precipitation in Texas. Playas planted to crops would also need to be drained quickly to prevent crop damage.

Artificial recharge rates through plain shafts were unsatisfactory—they accepted from 90 to 220 gpm. Modification of the shafts by hydraulically mining a cavity in the Ogallala sand 100 feet below ground level, increased the recharge rate up to 358 percent. Maximum rate with clear well-water was 788 gpm. That rate is satisfactory, say ARS scientists, for recharge through a single shaft.

Water containing suspended material was not included in this study which was conducted by ARS agricultural engineers D. C. Signor and V. L. Hauser, and soil scientist O. R. Jones at the Southwestern Great Plains Research Center, Bushland, Texas, in cooperation with the Texas Agricultural Experiment Station.■

Bacterium yields new WEED KILLER

THE SEARCH for biological weed killers has turned up a new prospect—rhizobitoxine.

Rhizobitoxine is toxic to plants through a mechanism which does not exist in animals. Therefore, there is a good chance that it will be relatively low in toxicity to animals. And, happily, it is degraded by microorganisms in 2 or 3 days after reaching the soil.

Rhizobitoxine is made by certain strains of the bacterium *Rhizobium japonicum*, a nitrogen-fixing organism in the soil, and was first found in the nodules of soybeans. ARS scientists later produced rhizobitoxine in nutrient solution cultures in amounts sufficient for identification and biological testing.

The use of rhizobitoxine as a herbicide, however, will depend on whether it can be chemically manufactured easily and cheaply.

ARS soil scientist L. D. Owens, who has been studying rhizobitoxine at Beltsville, Md., says it works like this:

When a plant is in the process of building protein, a molecule called cystathionine in the plant must be cleaved or cut by an enzyme to allow the building process to run its course. The plant toxin rhizobitoxine "looks" like cystathionine to the enzyme that does the cleaving and "fools" it into clinging to the toxin rather than to cystathionine. In fact, the enzyme has a greater affinity for the toxin than to cystathionine. Growth is stopped at that point.

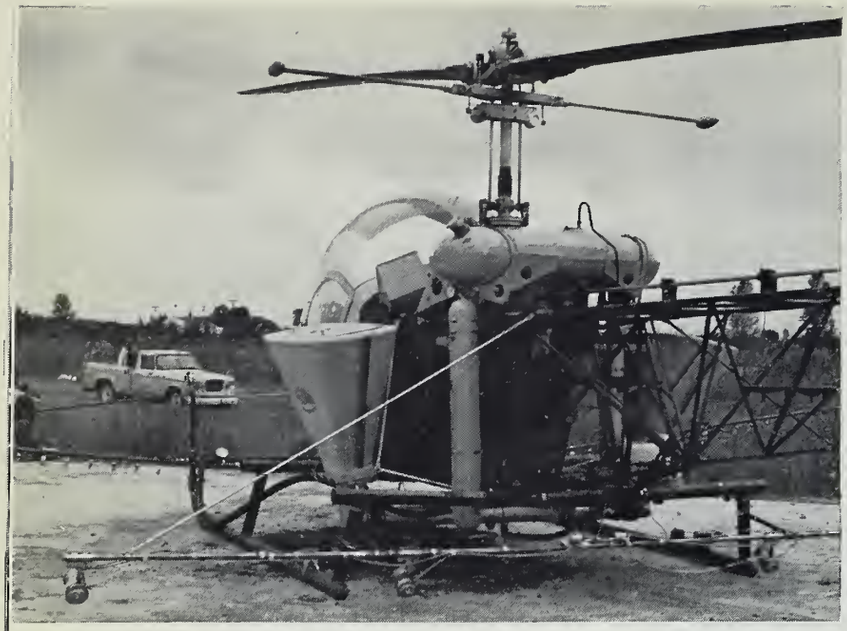
In the digestion of plant protein by animals, the cystathionine-cleaving enzyme is not involved, and animals should not be affected unless other mechanics of action are involved.

A number of experiments indicated that rhizobitoxine is a broad-spectrum herbicide and is toxic at low concentrations to many weed and crop species. But since rhizobitoxine attacks young growth and new leaves with little effect on older growth, it could be sprayed on fields before the crop emerges without danger to the crop. Directed-spray application, under the leaves of an established crop, could probably be carried on throughout the season.

Laboratory tests showed that rates as low as 0.2 pound per acre are enough in most cases to get the job done, but field tests must await the production of greater quantities of rhizobitoxine. Scientists also tested various mixtures to find a solvent for dispersing rhizobitoxine that will aid in leaf penetration. But, so far, toxicity is obtained only with a 50:50:1 solution of ethanol, water, and glycerol.

ARS plant physiologist J. F. Thompson, Ithaca, N.Y., and S. Guggenheim, National Heart Institute, Bethesda, Md., aided Owens in the study of rhizobitoxine.■

Bacterium in soybean root nodules normally fix nitrogen for the plant. In addition, certain strains of R. japonicum, *produce a toxin—dubbed Rhizobitoxine—that induces chlorosis in susceptible varieties (ST–4605–3, ST–4605–8).*



Left: *Helicopter with ARS–FS mounted sprayer (PN–1779).* **Right:** *Oregon forest is test-sprayed (PN–1780).*

HELICOPTER SPRAYERS

may rescue infested Forests

BIOLOGICAL CONTROL of a damaging insect pest of Western forests is now possible with helicopter-mounted sprayers.

Designed for aerial application of polyhedrosis virus to control the Douglas-fir tussock moth, the equipment may eventually be used with other microbial insecticides and against other pests. It was jointly developed and tested by ARS and USDA's Forest Service.

Polyhedrosis virus, a pathogen effective against certain insects, leaves no potentially hazardous residues and is harmless to man and beneficial forms of life. The experimental insect pathogen is a promising alternative to conventional insecticides in controlling the tussock moth, an insect that defoliates and sometimes kills true firs and Douglas-firs in western North America.

Equipment designed for use with conventional pesticides was adapted by a research team that included ARS agricultural engineer P. A. Boving and pilot R. G. Winterfeld, Forest Grove, Oreg., and FS entomologist Bohdan Maksymiuk and technician R. D. Orchard, Corvallis, Oreg.

The researchers developed ultra-low-volume (ULV) and low-volume (LV) spray systems that approximate the ideal performance specifications already established in previous research. Microbial insecticides are applied in water-base spray formulations as suspensions of living organisms.

The ULV system employs four commercial spinning nozzles and applies 0.2 gallons per acre (gpa) in a swath 100 feet wide when the helicopter's forward speed is 45 miles an hour. A spraying pressure of 30 pounds per square inch (psi) is obtained from an air tank and pressure regulator connected to a 6-quart spray tank.

Depending upon the number of commercial flat-fan nozzles used, the LV system applies 1 to 2 gpa at a helicopter speed of 45 mph. The LV equipment covers a 100-foot swath, and the application pattern is triangular in shape, avoiding high buildups where the spray swaths overlap.

An auxiliary engine drives the LV system pump, maintaining a spray pressure of 43 psi. To avoid heat buildup that would damage the pathogen, researchers substituted this pump for the conventional drive system with the pump mounted directly on the helicopter engine—an arrangement used with conventional insecticides. All components were selected to minimize possible mechanical injury to the pathogen.

Performance of both systems was determined in test flights over a sampling platform. Dye was added to the spray formulation but the virus was omitted in these tests. Dye collected on plastic cards or stainless steel plates was later analyzed in the laboratory to determine spray atomization and deposit patterns.

A formulation of the polyhedrosis virus developed by FS, designated Corvallis 1967, has been applied successfully on open ground and forest areas with the ULV and LV equipment.■

Invisible Color Codes

P.L. 480 Researchers seek new marking systems for seeds

INVISIBLE COLOR CODES easily deciphered by physical or chemical methods may revolutionize seed blending and certification procedures.

Variety, age, time of harvest, and geographical source have an important bearing on seed quality, use, and certification. But seeds often lose their identity in the marketing system, and visibly marked seed are a financial loss to seedsmen because of off-colors.

An invisible seed coding system, however, could overcome this objection and prevent the crop losses incurred when the wrong seed are planted. It could also expedite seed blending, enabling blenders to detect the exact stage at which a homogeneous blend can be made. Such a blend would make test sampling more reliable and permit the quick and accurate certification by percentage of different species and percentage of guaranteed germination. Optimum timing and speed in the blending operation could also prevent abrasive or mechanical damage to seedcoats.

To develop an efficient, invisible marking system, Israeli scientists, working under a Public Law 480 grant, have determined acceptable chemicals and methods for applying and identifying invisible markers on seed of 30 representative species.

The Israelis used both wet and dry techniques to mark seed. The chemicals tested by the scientists and the corresponding methods of identification were: minor elements and inorganic solutions (microchemical), fluorescent substances (physical), and organic powders (chemical).

Recommended markers as well as rejected treatments varied for each of the species tested. The Israelis found that a dry method of marking is preferable, when possible.

Recommendation or rejection of markers and application techniques was based on seed appearance and germination performance and on the efficiency of fungicides and other routine seed treatments.

Fluorescent dyes proved promising because they could be rapidly identified under ultraviolet light. The ultraviolet technique, however, requires the use of a blank, or control, for comparison.

Wet marking provided a more uniform seed covering, but required more drying time. ARS sponsoring scientist L. W. Woodstock at Beltsville, Md., says that if further studies along these lines are undertaken, the use of rapid drying organic solvents might be investigated. He adds that spray application of this kind of marking substance combined with turbulent air movement through the seeds should permit almost instantaneous marking and drying.

The Israeli work was conducted at the Volcani Institute of Agricultural Research, Beit Dagan, under the co-direction of principal investigators H. Gelmond and D. Lachover of the Institute.

Treated Water Curbs Tomato Decay

ADDING CHLORINE and a surfactant to the water used for field-washing Florida tomatoes can prevent much of the decay that otherwise may develop during shipment and storage.

Tomatoes grown on the sandy soils of Central and Southern Florida—where 55 percent of the Nation's winter supply of fresh tomatoes is produced—are often field-washed to remove the sand that may scar or puncture the fruit skin. When changing the bath during the day is impractical because the field is far from a water source, decay-causing organisms build up in the water and infect the tomatoes.

In laboratory tests, ARS plant pathologist R. H. Segall, Orlando, Fla., found that supplementing chlorine water with a surfactant—a wetting agent to decrease the water repellency of the shiny fruit surface—reduces bacterial soft rot and bacterial necrosis on such tomatoes.

Segall field-washed sample tomatoes in plain water or in a concentration of 50 parts per million of chlorine (as sodium hypochlorite) and 100 ppm Santomerse F85 commercial surfactant (linear dodecylbenzene sodium sulfonate). After simulated packinghouse washing and sorting, the samples were held at 60° F. until ripe.

Before being held at 60°, other samples were kept at 35° for 3 days to simulate cool preharvest weather or accidental postharvest chilling. Exposure to cold can increase decay.

In the unchilled fruit, adding the chlorine-surfactant mixture to the wash water reduced soft rot an average of 65 percent and reduced necrosis an average of 53 percent.

Chilled tomatoes washed in treated water averaged 82 percent less soft rot and 21 percent less necrosis than tomatoes washed in untreated water.

In his tests, Segall used Homestead tomatoes harvested commercially in the mature-green stage. Most tomatoes for fresh sales are harvested while they are still green.

Sodium hypochlorite and Santomerse F85 are approved by the Food and Drug Administration and by USDA for postharvest applications.■

Top: *Close-up of electrode implanted in antenna of conenose bug (BN–31992).* **Bottom:** *Conenose bug on man's arm (BN–33506).*

BREATH LURES BLOODSUCKING BUGS

BLOODSUCKING conenose bugs are lured to their victims by human breath—a finding that could be turned against these pests.

The bugs occasionally attack humans and domestic animals, inflicting painful bites. In some parts of the world, they transmit Chagas' disease. They are the black sheep of a beneficial family of insects called assassin bugs, most of which prey on undesirable species of insects.

In recent tests at Gainesville, Fla., ARS entomologist M. S. Mayer found that tiny, hairlike projections on the bugs' antennae generated electrical impulses when he breathed on the insects. Mayer attached recording devices with fine wires to various segments on the antennae and found different responses to certain stimuli.

Although the strongest response occurred when he breathed on the bugs, his electronic wiretapping recorded no response when the insects were exposed to carbon dioxide, a major constituent of the breath. Several other gases associated with the breath also evoked no response. Conenose bugs bite various parts of the body, however, and other attractants beside the breath may also lure these pests.

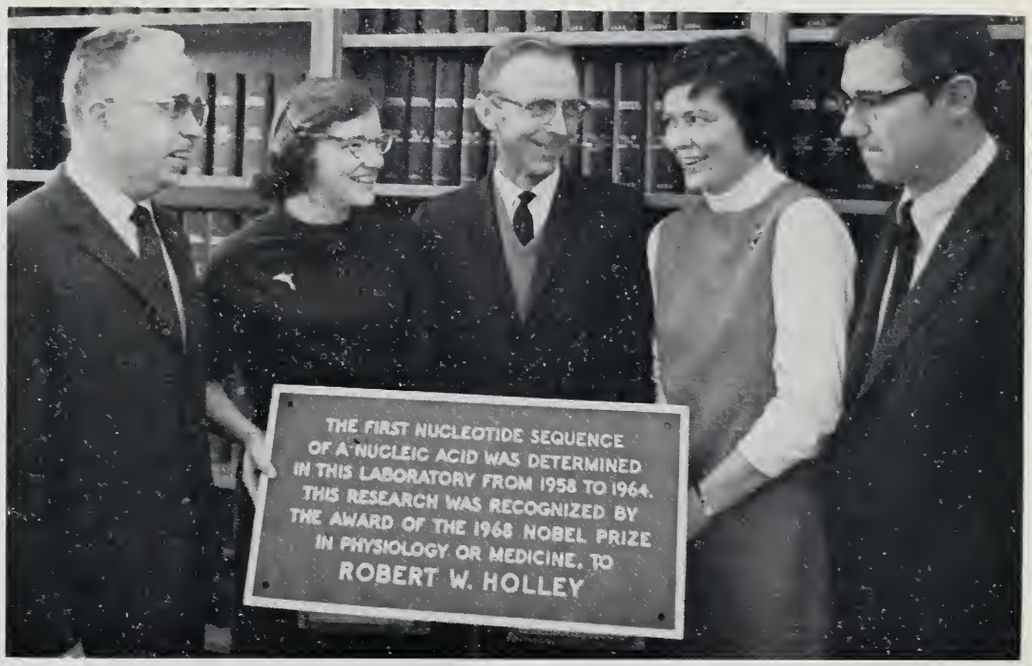
Identification of the factors that stimulate the insects could lead to artificial lures for control of the pests. For example, the pests could be led to traps or selected areas treated with insecticides—eliminating the need to apply control measures over larger areas in the home or outdoors.■

AGRISEARCH NOTES

Plaque Honors Nobel Laureate

The nucleic acid research which won R. W. Holley a 1968 Nobel Prize is commemorated in a bronze plaque recently mounted at USDA's Plant, Soil, and Nutrition Laboratory at Cornell University, Ithaca, N.Y.

The Nobel laureate attended the brief ceremony. Formerly with ARS and now with Cornell, Holley was on leave this year at the Salk Institute of Biological Studies in La Jolla, Calif. He was there in October when the $70,000 prize was announced. It was awarded jointly to three American professors who had conducted independent research on the interpretation of the genetic code and its function in protein synthesis.



Holley's colleagues designed the plaque and featured his name. Chemists who assisted him in the Nobel Prize-winning work are G. A. Everett, Jean Apgar, Holley, S. H. Merril, and J. T. Madison (Photo: Ithaca Journal).

W. H. Allaway, the laboratory director, noted that this was the first time research from a USDA laboratory had been acknowledged by a Nobel award. Holley added that the work required to purify an RNA and determine its structure was so great that one person could not do it alone. "During the years we worked on the project, many people helped—USDA scientists, postdoctoral fellows, and Cornell graduate students. Without their help, the work could not have been done."

Holley, who first discovered the group of small nucleic acids called "transfer" RNAs, noted that it was particularly satisfying to have been able to carry the research all the way from the discovery of a class of compounds to the determination of the structure of one of them (AGR. RES. June 1965, p. 3).

The "transfer" RNAs play an important part in the process by which any living cell makes protein. Understanding this process may someday enable man to control diseases that result when cells make defective proteins.

Mulching Poultry Litter

Spreading 5 tons or more of poultry litter as a mulch on fallow soil utilizes an important byproduct without the runoff and water pollution problems that develop at lower application rates.

These were the conclusions drawn from preliminary studies of litter (pine shavings and poultry manure) by ARS researchers at the Southern Piedmont Conservation Research Center, Watkinsville, Ga., in cooperation with the Georgia Agricultural Experiment Stations.

Massive quantities of poultry litter are produced daily in the United States, presenting questions of handling and disposal. Although the litter had earlier been tested as a mulch, researchers found that the runoff of ammoniacal nitrogen and other pollutants from the litter was too great for practical use.

Recent tests, however, show that the heavier the mulch, the longer runoff is delayed. The researchers broadcast poultry litter mulch at rates of 0 to 40 tons per acre on fallow plots of Cecil soil with a 7 percent slope. Rainfall was applied by simulator at 2½ inches per hour for 2 hours.

Mulch applied at rates of 10, 27, and 40 tons per acre delayed initial runoff by 20, 29, and 52 minutes, respectively. The longer delays at the higher application rates mean that little or no runoff occurs with most rains.

The more practical application of 10 tons per acre resulted in no runoff and no surface water pollution from the first inch of test rain. This indi-

UNITED STATES GOVERNMENT PRINTING OFFICE
DIVISION OF PUBLIC DOCUMENTS, WASHINGTON, D.C. 20402

OFFICIAL BUSINESS

POSTAGE & FEES PAID
United States Department of Agriculture

cates little or no pollution from the normal rainstorms that occur an average of once or twice each month in the area.

When 4 inches of rain was applied in 1½ hours, a rate simulating one of the infrequent severe storms, less ammoniacal nitrogen was recovered in washoff from the 10- and 27-ton plots than from the 5-ton plots.

ARS agricultural engineer A. P. Barnett, chemist W. A. Jackson, and soil scientist W. E. Adams expect future studies to include pasture soils and different methods of mixing poultry litter with the soil.

3rd Calf Born On Protein-Free Diet

A Shorthorn cow in the ARS herd at Beltsville, Md., set a record by giving birth to her third calf after having been on a protein-free diet from weaning for 5⅓ years. The father of the calf, an Angus bull, ate the protein-free feed from weaning for 3½ years.

Their experimental diet consists of sugar, starch, cellulose, minerals, vitamins, and urea. Although the urea in the feed has no direct feed value, microbes in the rumen of cattle can convert it into protein (AGR. RES. July 1967, p. 8).

Nutritionist R. R. Oltjen hopes that by capitalizing on this ability of microbes, the future human diet will continue to be enriched with meat and milk. Cattle would be fed increased quantities of forage, plant wastes, and non-protein additives that stimulate protein production.

The heifer calf born to parents on protein-free feed weighed a healthy 70½ pounds at birth. Her sole feed is mother's milk (ST–4606–9).

DDT Variant Does Break Down

Anaerobic bacteria—those living without air—can detoxify DDT, whether the standard chemical or its variant form, ortho-para DDT.

Ortho-para DDT makes up about 20 percent of the commercial product and is suspected of causing certain reproductive problems in birds (AGR. RES. Jan. 1969, p. 5).

In earlier studies, ARS scientists found that anaerobic bacteria convert DDT residues to DDD, a related, but much less toxic chemical (AGR. RES. May 1967, p. 13). This work was done with standard, purified DDT.

Now, ARS animal scientist G. F. Fries, working with rumen microorganisms, found that anaerobic bacteria in test tubes convert both standard and ortho-para DDT to DDD at the rate of 12 percent of the remaining residue per hour.

CAUTION: In using pesticides discussed in this publication, follow directions and heed precautions on pesticide labels. Be particularly careful where there is danger to wildlife or possible contamination of water supplies.

U.S. GOVERNMENT PRINTING OFFICE: 1969